FIG. 1

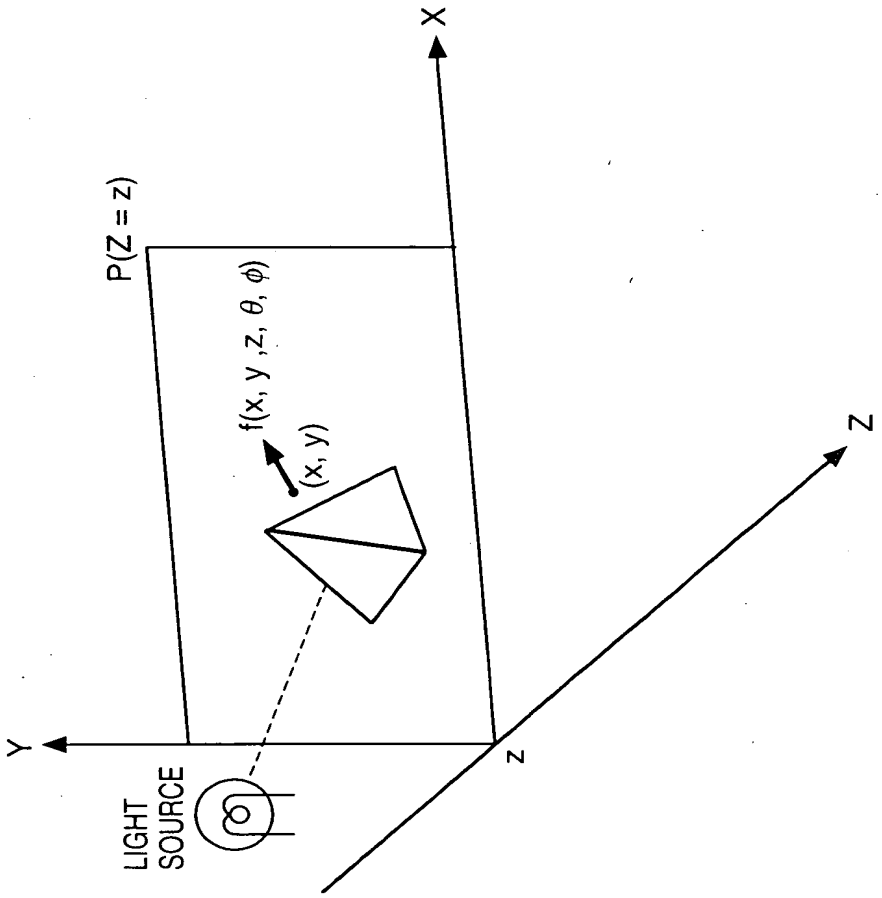

FIG. 2

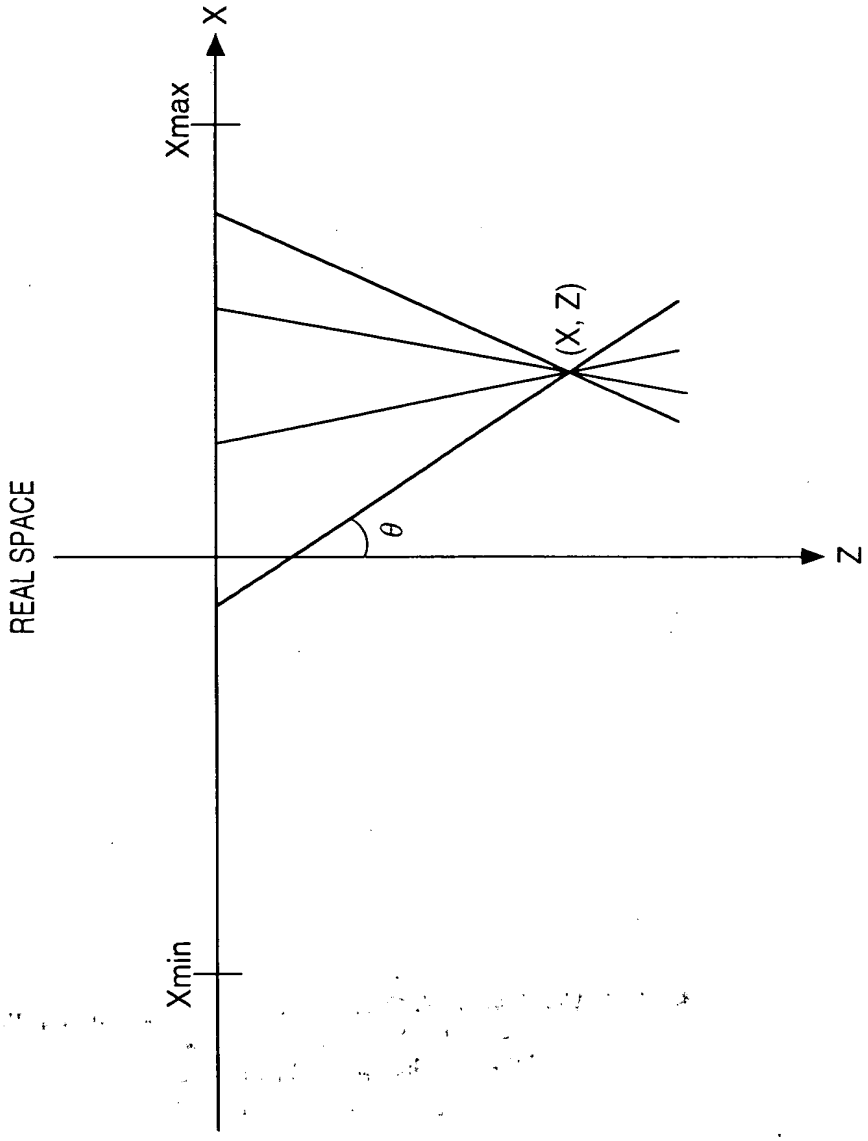

FIG. 3

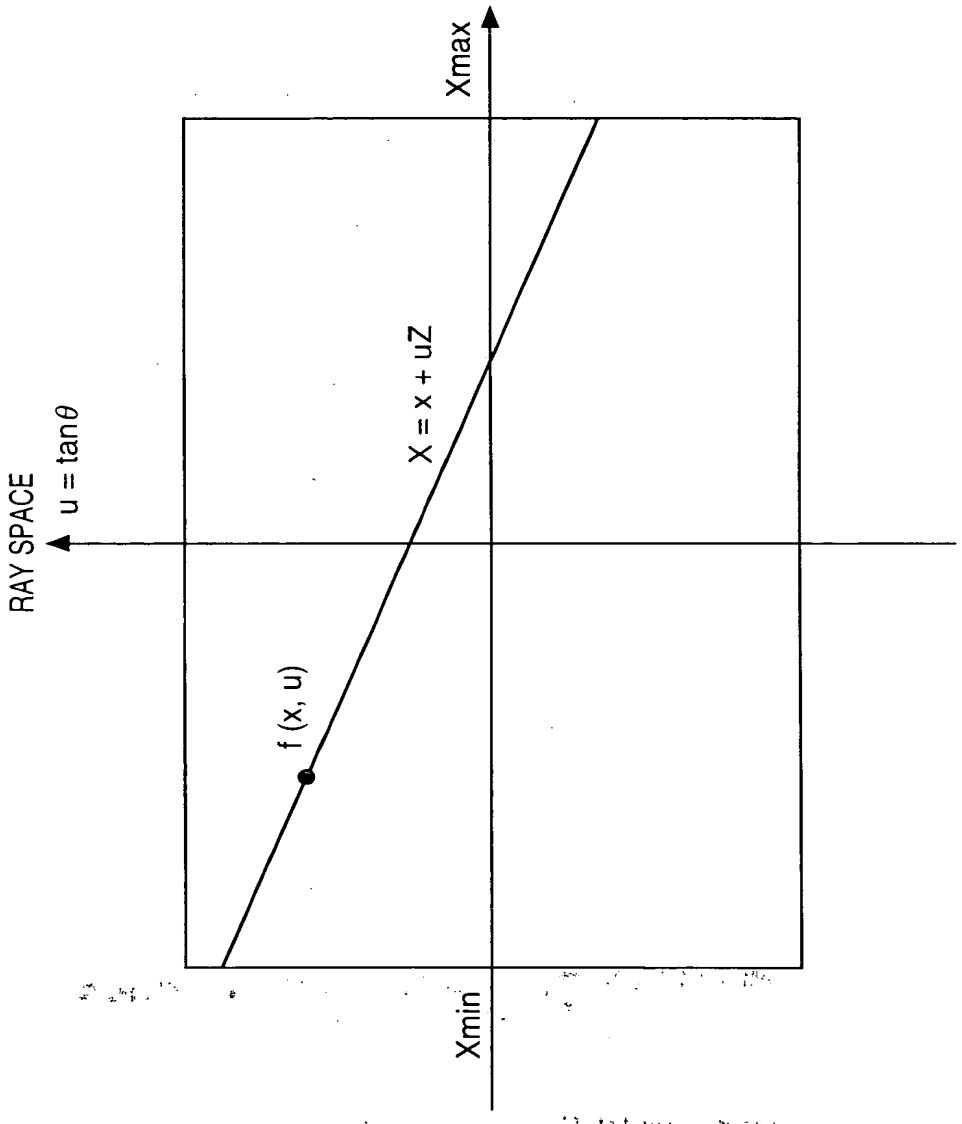

FIG. 4

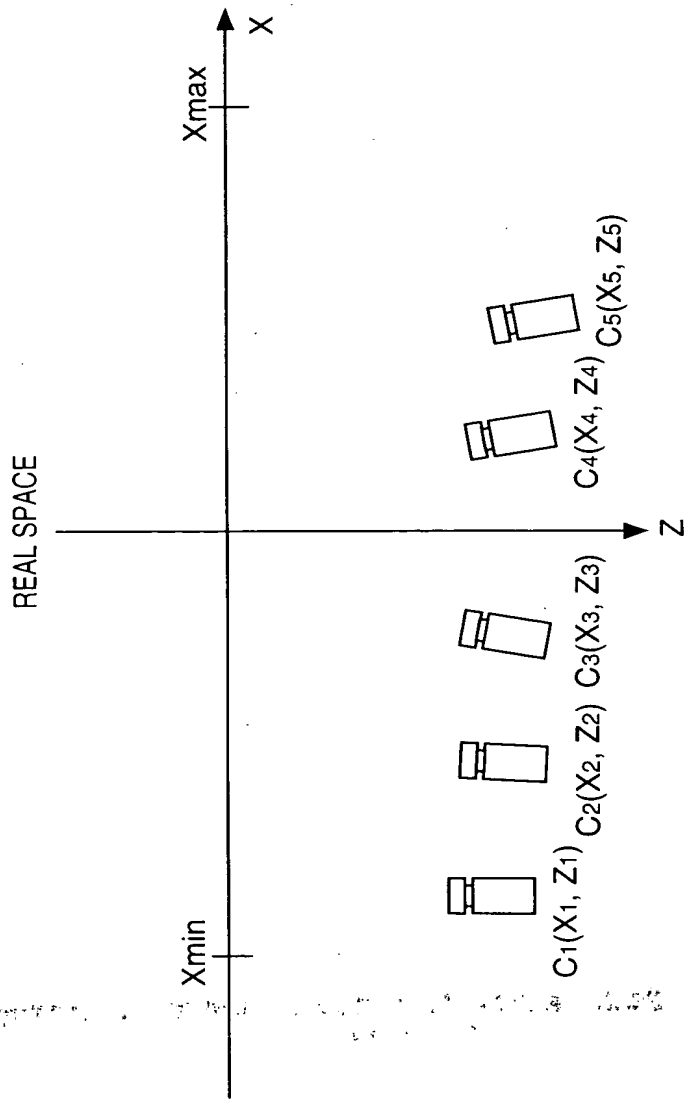

FIG. 5

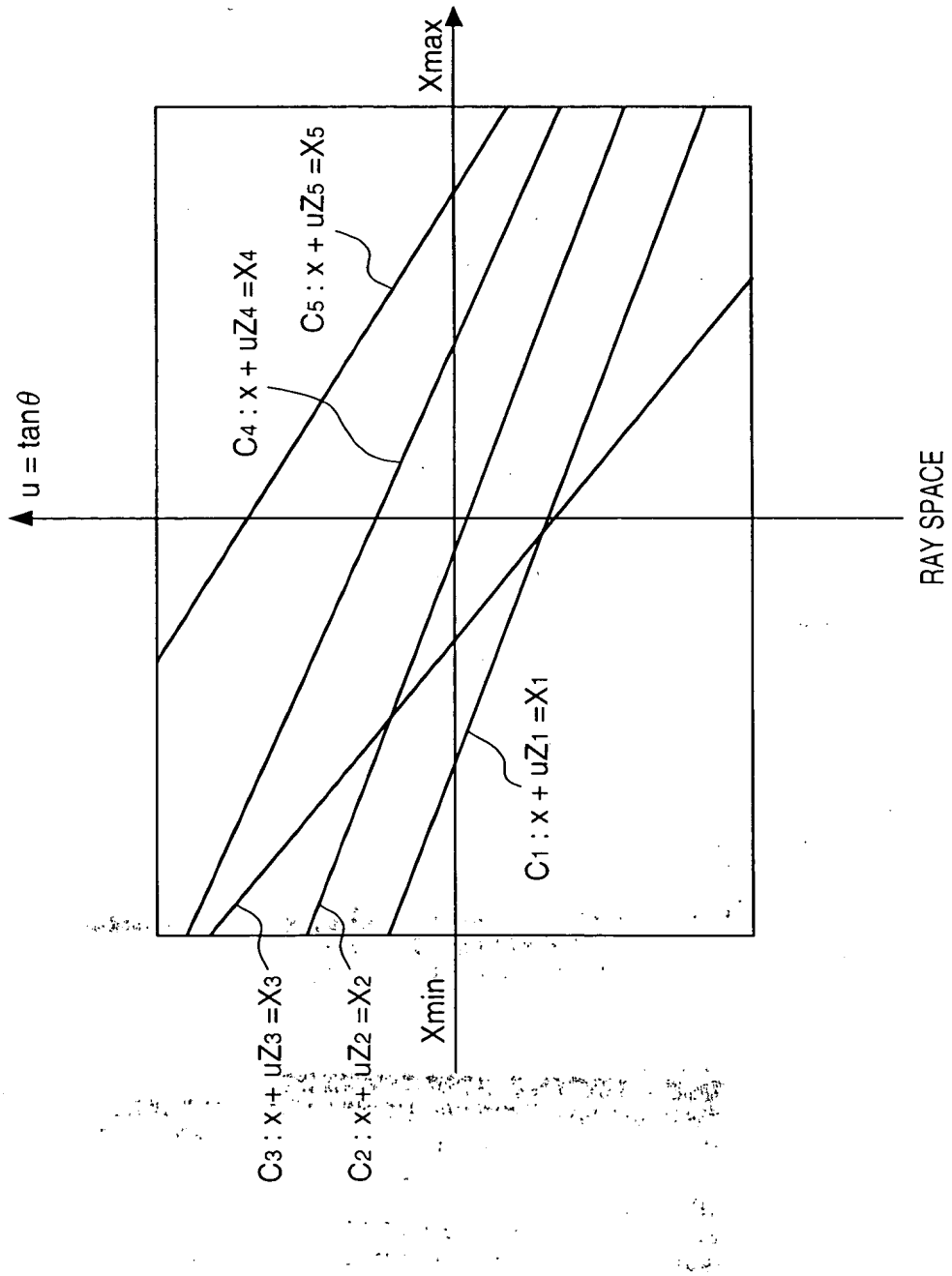
Xmax
u = tanθ
C4 : x + uZ4 =X4
C5 : x + uZ5 =X5
C1 : x + uZ1 =X1
C3 : x + uZ3 =X3
C2 : x + uZ2 =X2
Xmin
RAY SPACE

FIG. 6

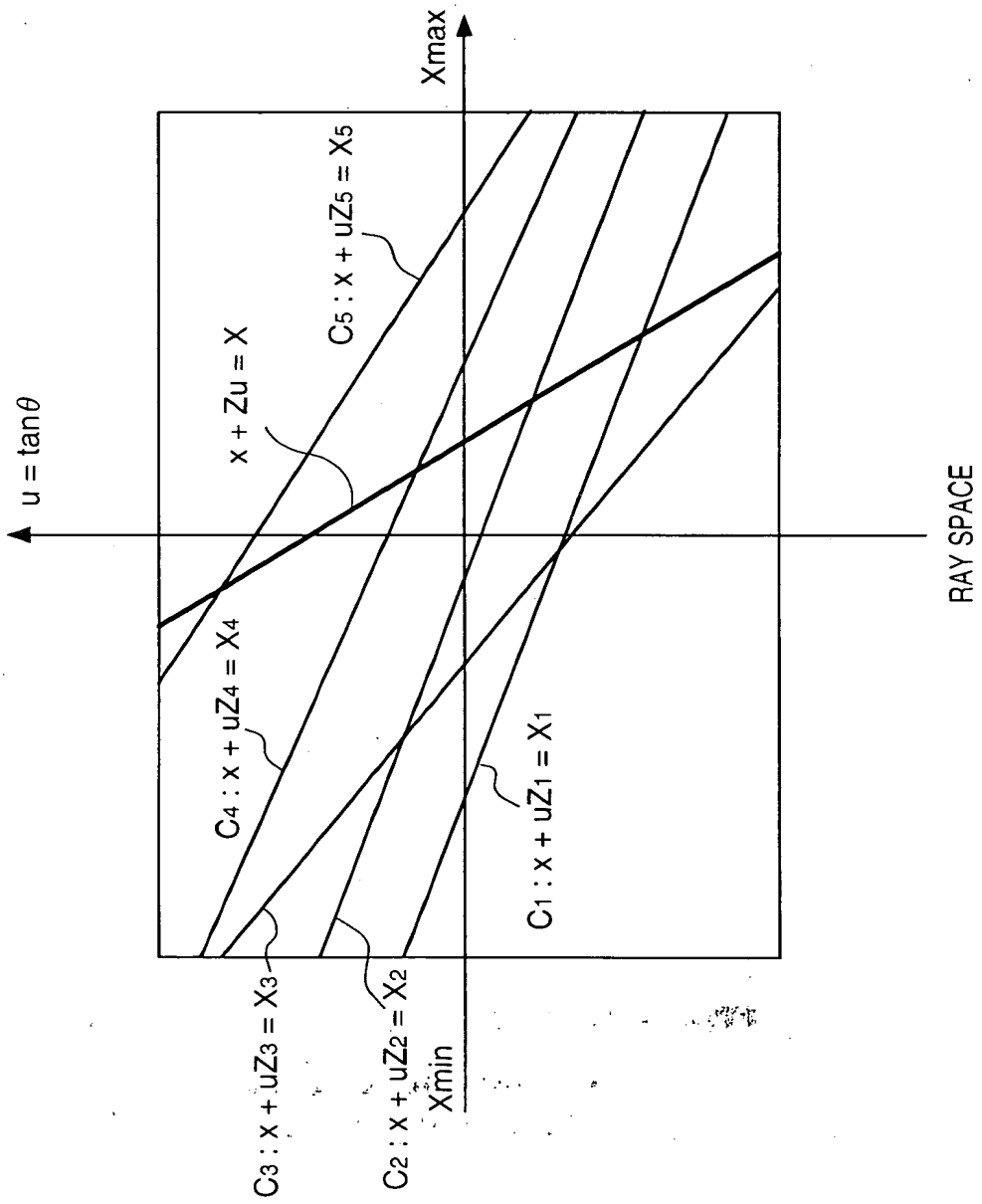
Xmax
u = tanθ
x + Zu = X
C5 : x + uZ5 = X5
C4 : x + uZ4 = X4
C3 : x + uZ3 = X3
C2 : x + uZ2 = X2
C1 : x + uZ1 = X1
Xmin
RAY SPACE

FIG. 7

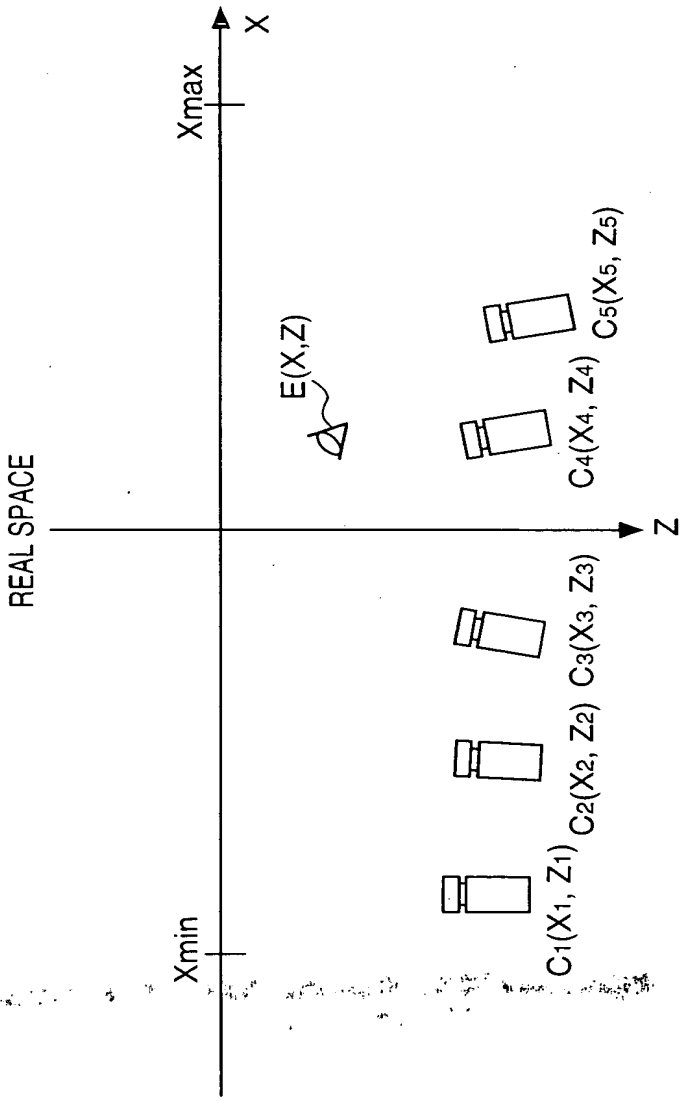
REAL SPACE
X
Xmax
Xmin
Z
E(X,Z)
C1(X1, Z1)
C2(X2, Z2)
C3(X3, Z3)
C4(X4, Z4)
C5(X5, Z5)

FIG. 8

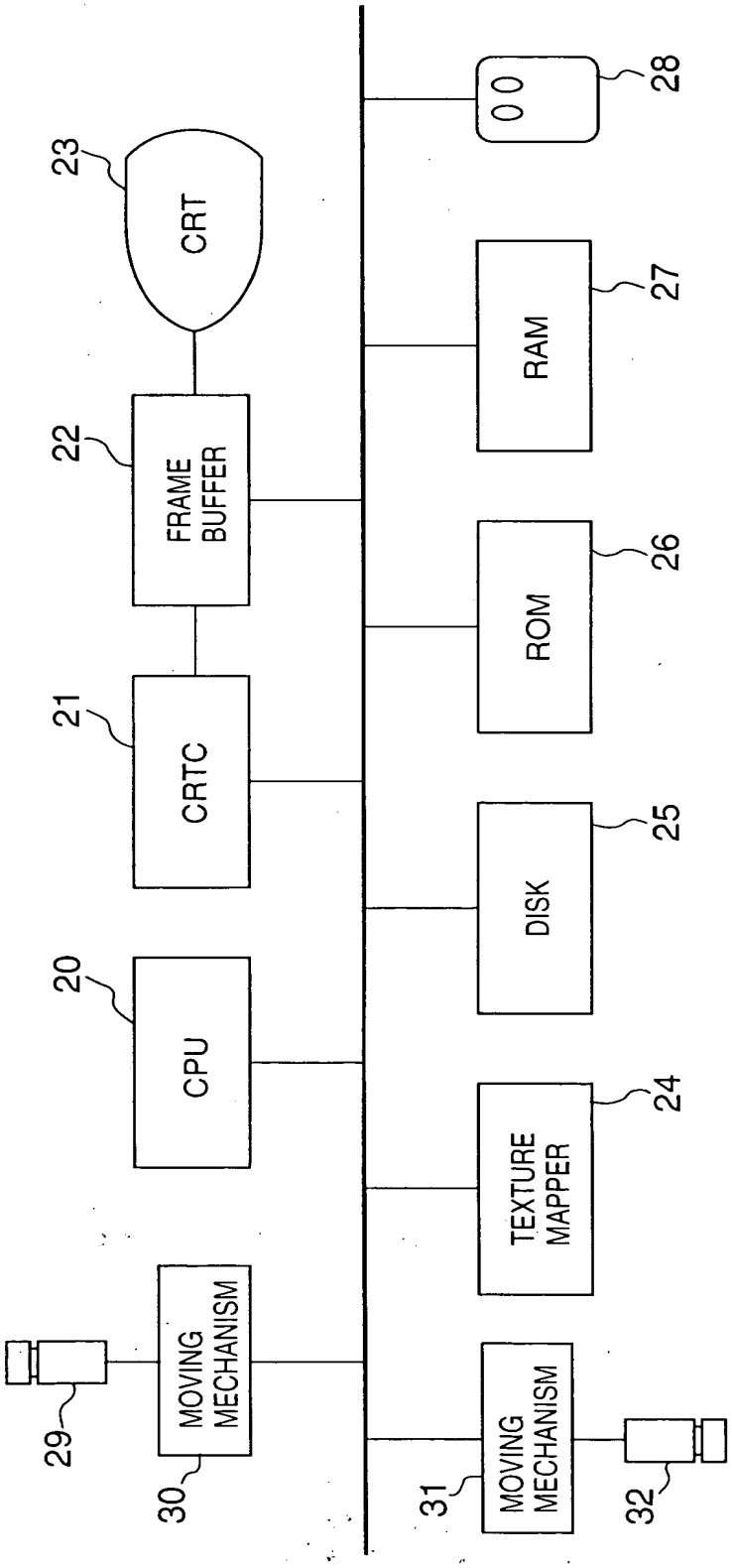
CPU
20
CRTC
21
FRAME BUFFER
22
CRT
23
MOVING MECHANISM
29
30
MOVING MECHANISM
31
32
TEXTURE MAPPER
24
DISK
25
ROM
26
RAM
27
28

FIG. 9

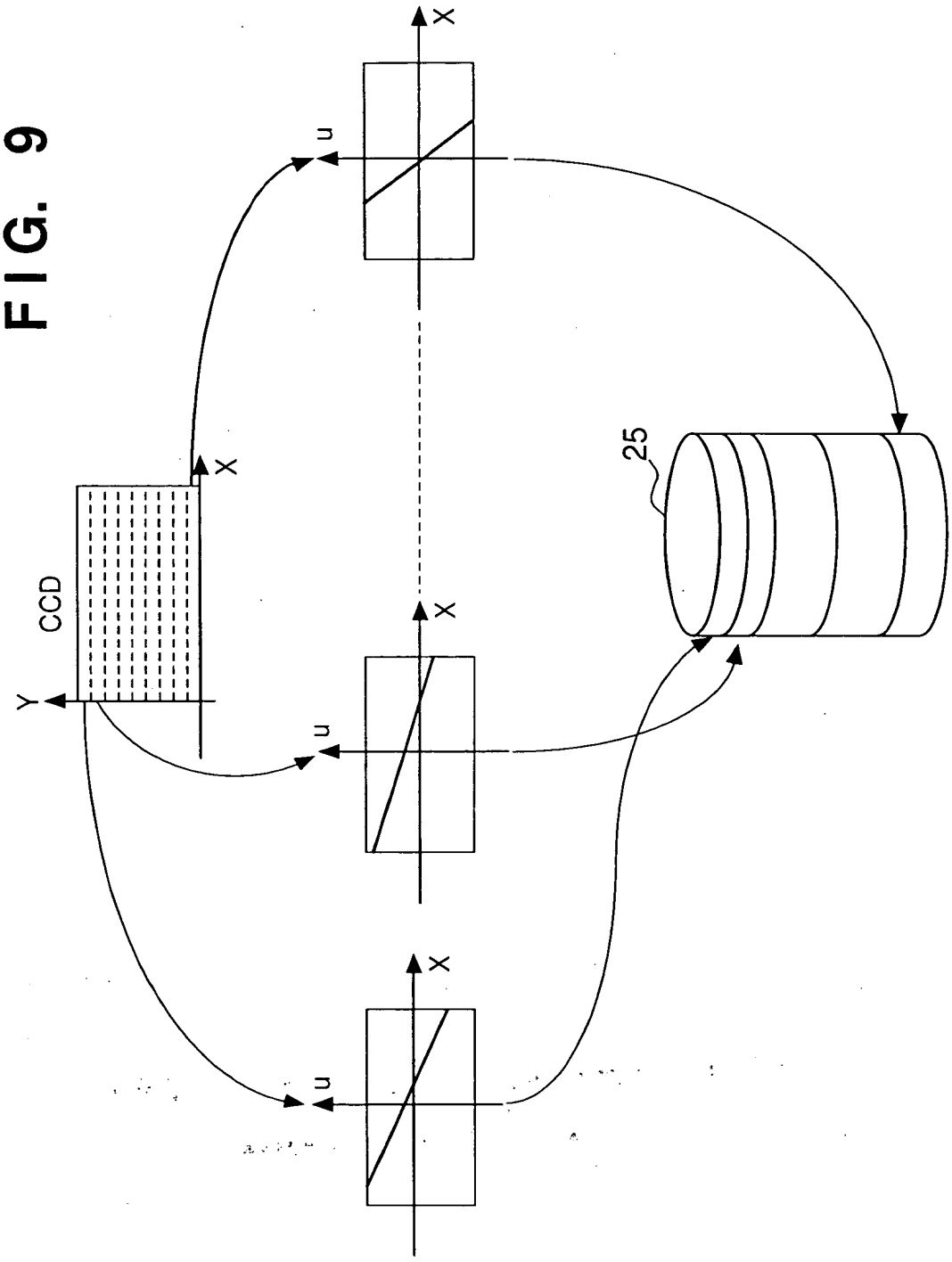

FIG. 10

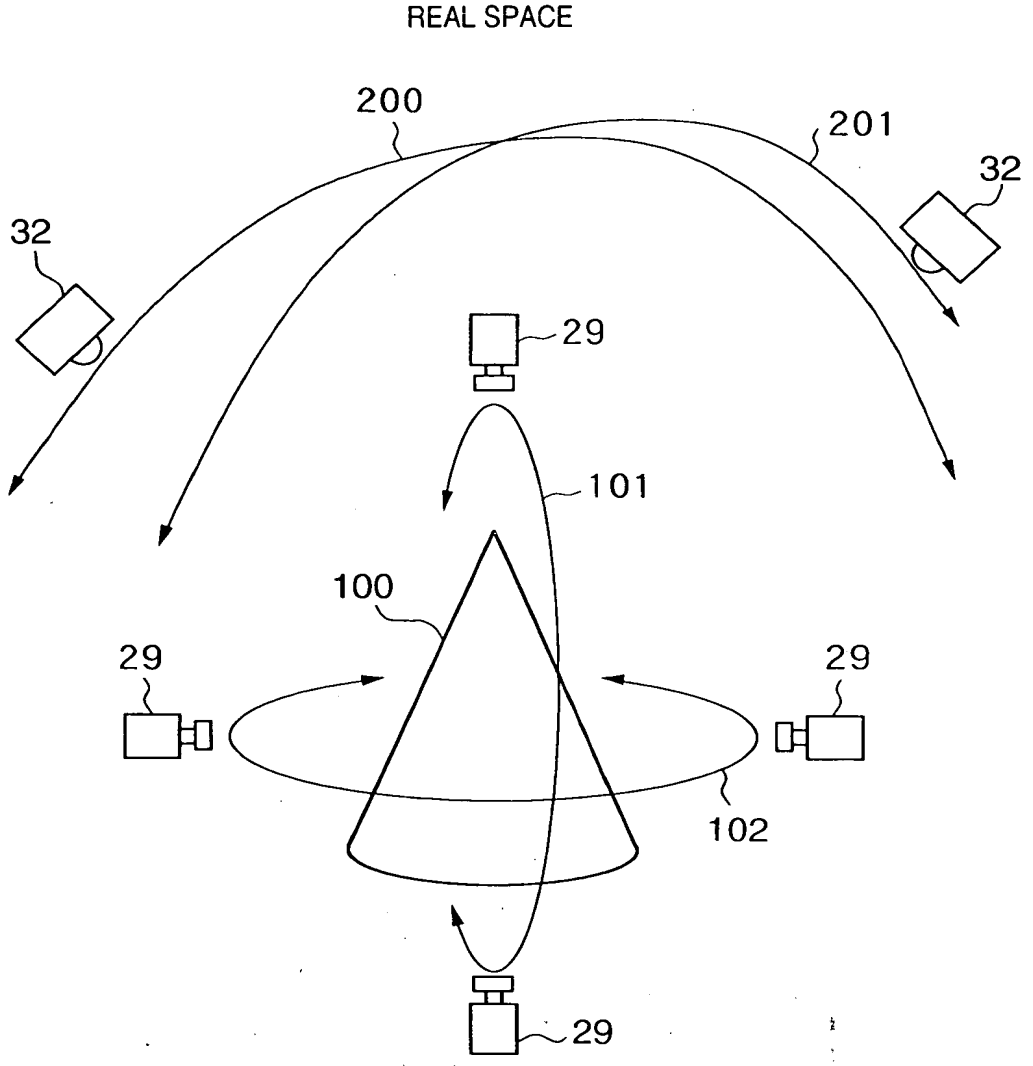

FIG. 11

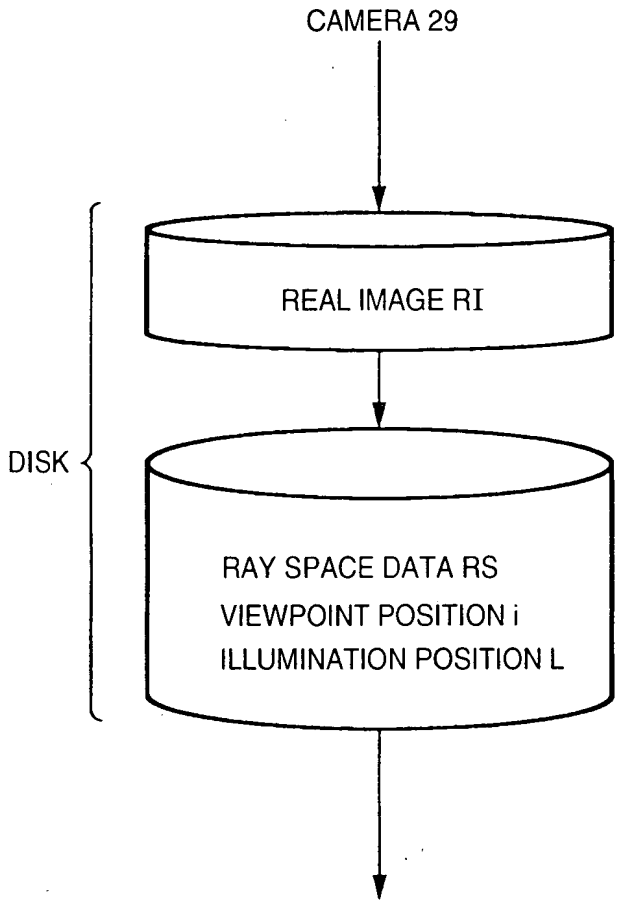
CAMERA 29
REAL IMAGE RI
DISK
RAY SPACE DATA RS
VIEWPOINT POSITION i
ILLUMINATION POSITION L

FIG. 12

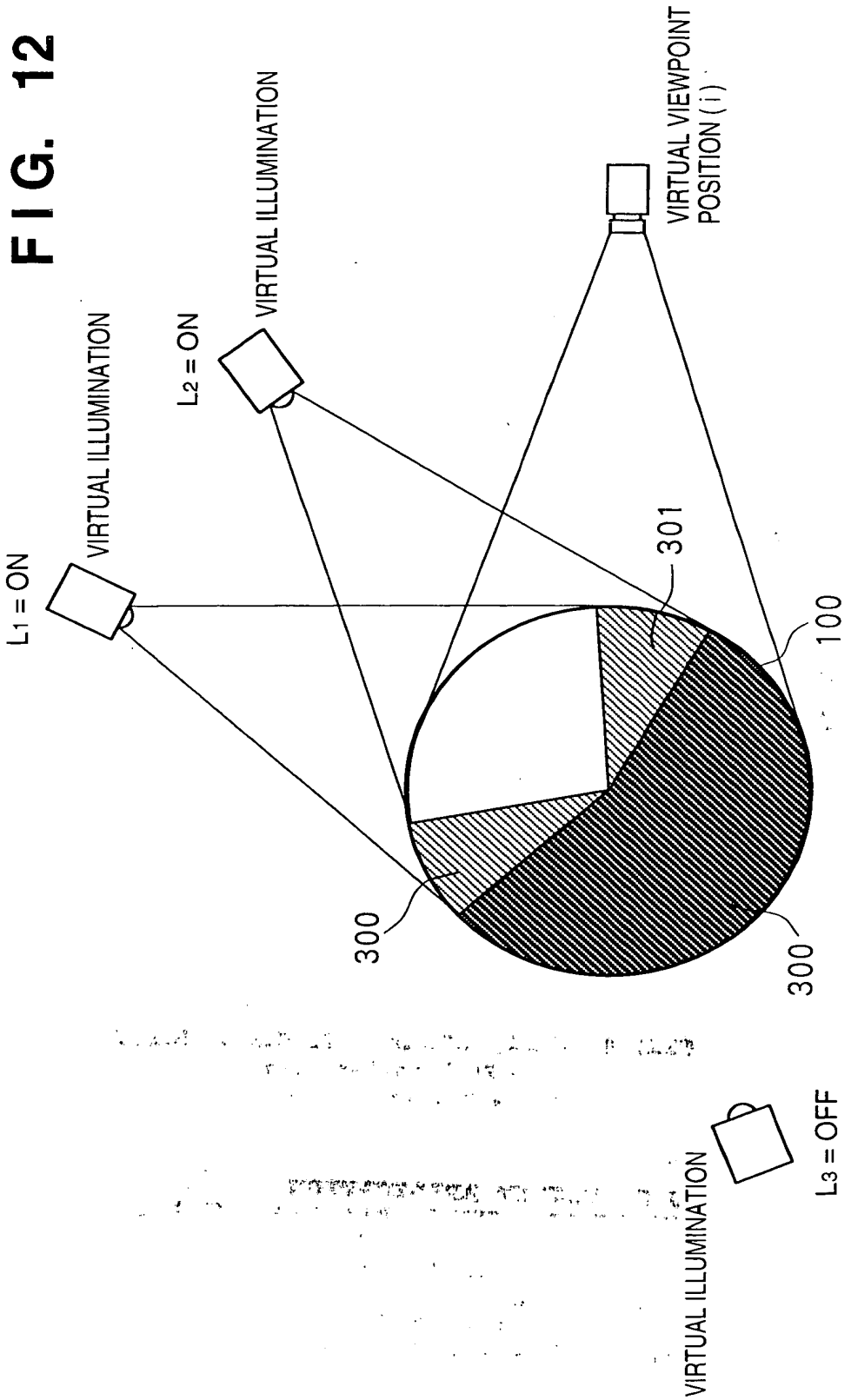
VIRTUAL VIEWPOINT POSITION (i)
VIRTUAL ILLUMINATION
L1 = ON
VIRTUAL ILLUMINATION
L2 = ON
VIRTUAL ILLUMINATION
L3 = OFF
301
100
300
300

FIG. 13

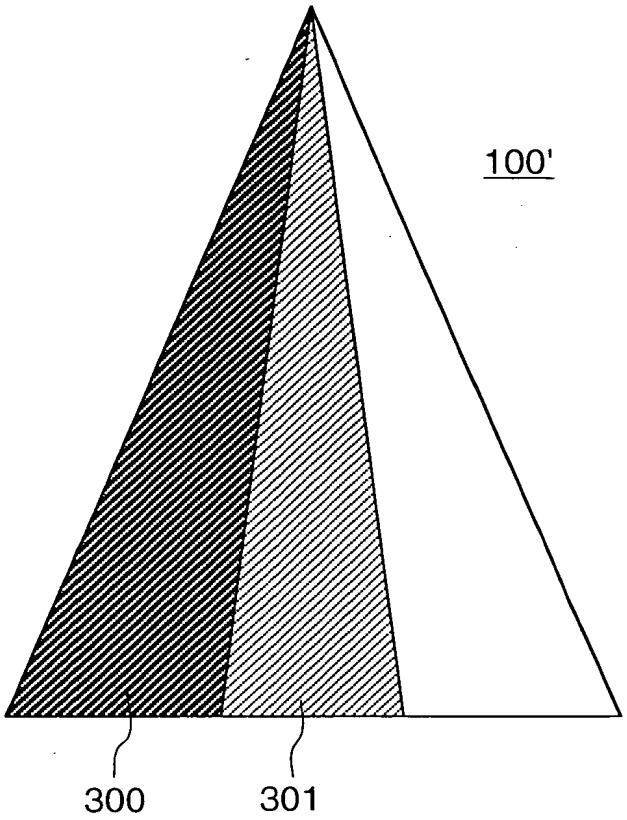

FIG. 14

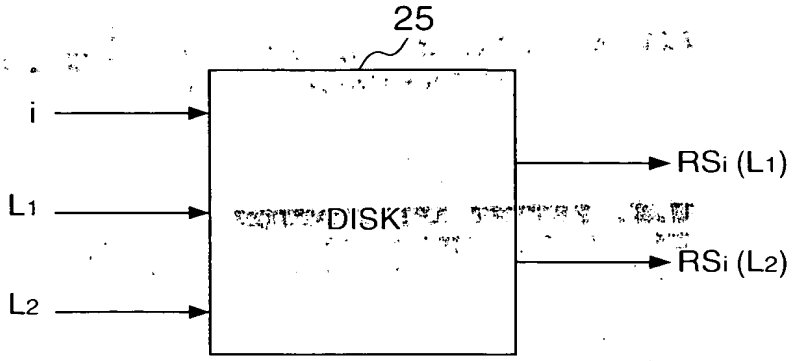

FIG. 15

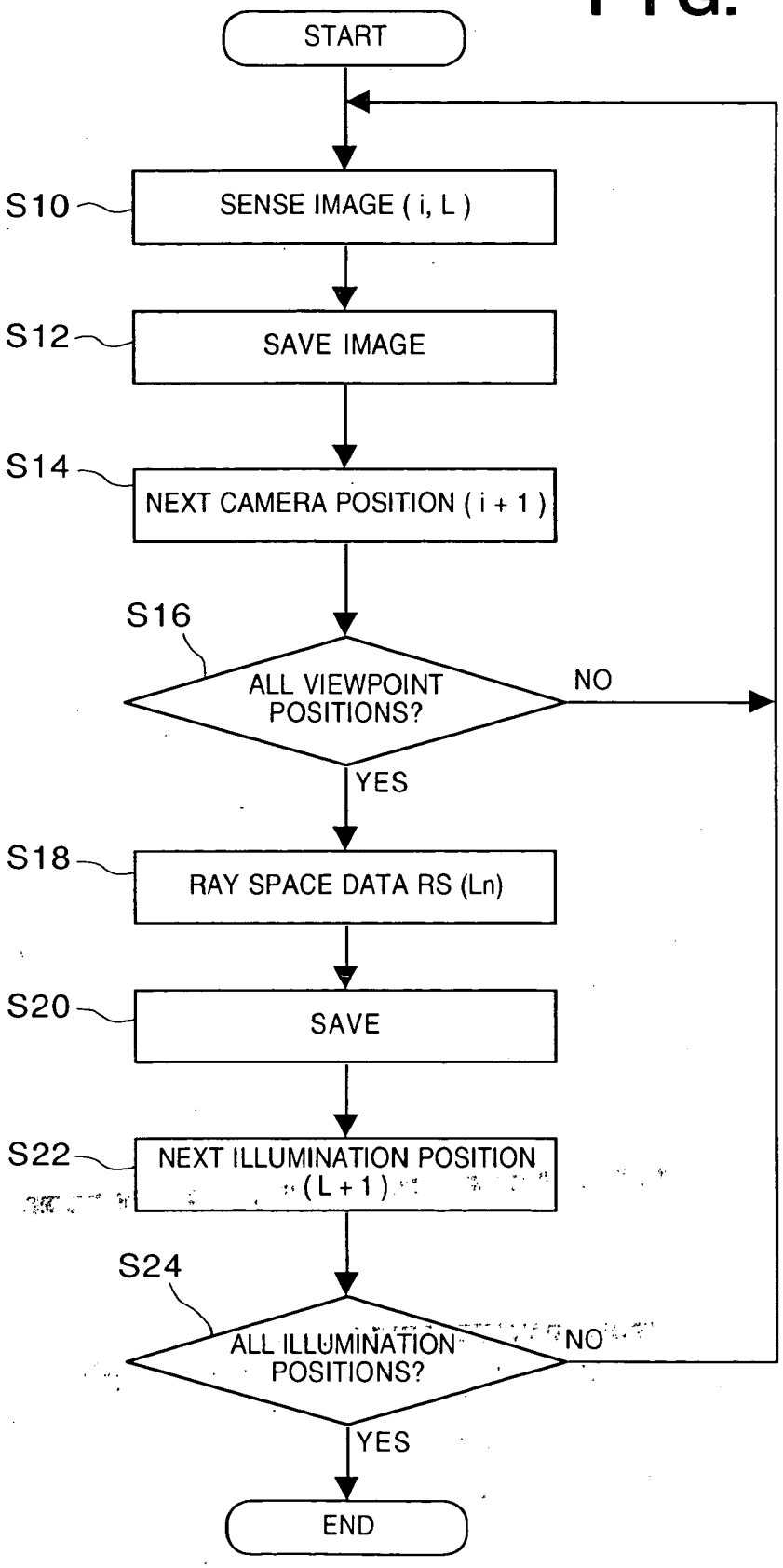
START
S10
SENSE IMAGE (i, L)
S12
SAVE IMAGE
S14
NEXT CAMERA POSITION (i + 1)
S16
ALL VIEWPOINT POSITIONS?
NO
YES
S18
RAY SPACE DATA RS (Ln)
S20
SAVE
S22
NEXT ILLUMINATION POSITION (L + 1)
S24
ALL ILLUMINATION POSITIONS?
NO
YES
END

FIG. 16

ILLUMINATION ID	ON / OFF	POSITION	INTENSITY	COLOR
L_1				
L_2				
L_3				
⋮				
⋮				

FIG. 17

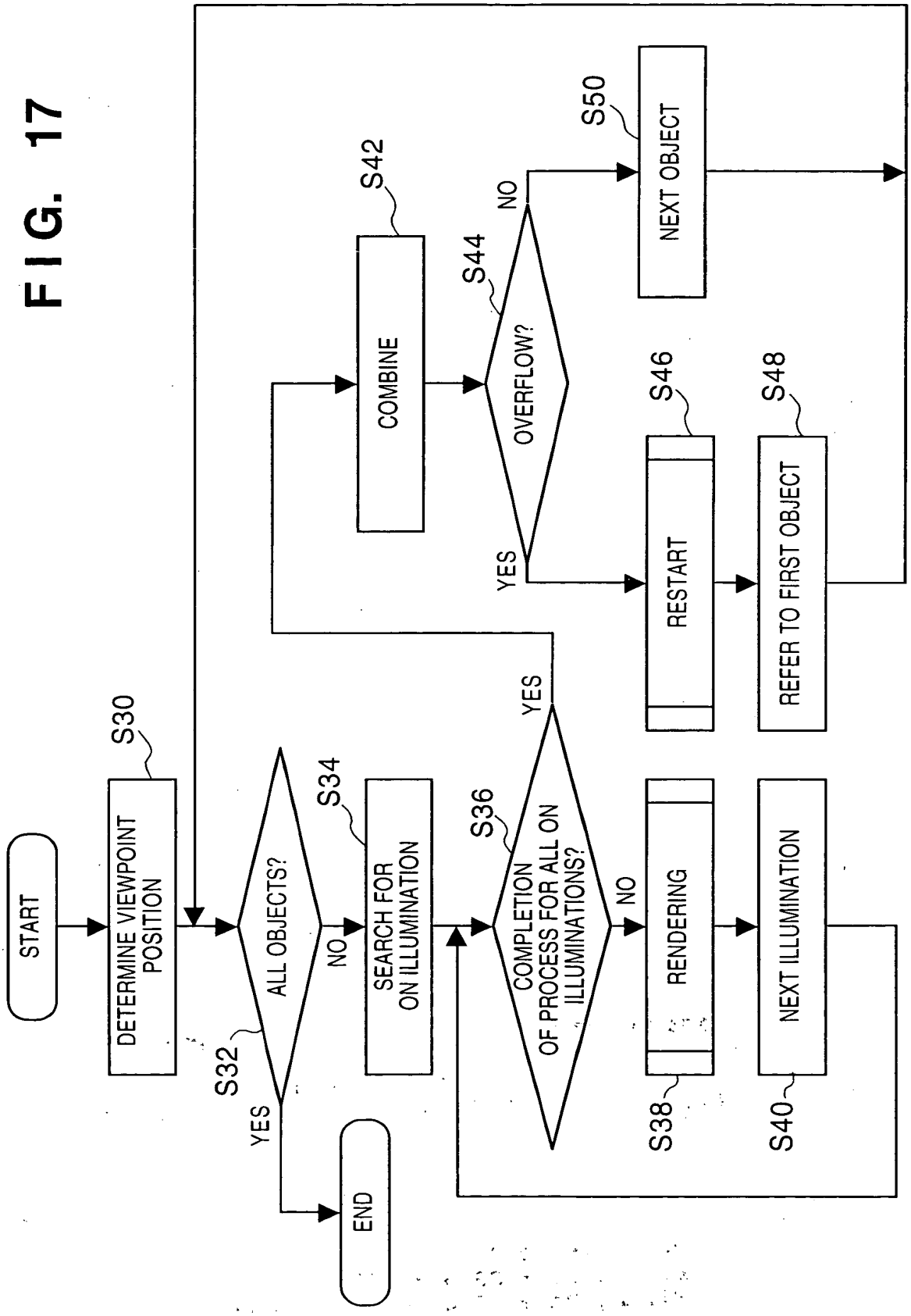
START
DETERMINE VIEWPOINT POSITION
S30
ALL OBJECTS?
S32
YES
END
NO
SEARCH FOR ON ILLUMINATION
S34
COMPLETION OF PROCESS FOR ALL ON ILLUMINATIONS?
S36
YES
NO
RENDERING
S38
NEXT ILLUMINATION
S40
COMBINE
S42
OVERFLOW?
S44
NO
YES
NEXT OBJECT
S50
RESTART
S46
REFER TO FIRST OBJECT
S48

FIG. 18

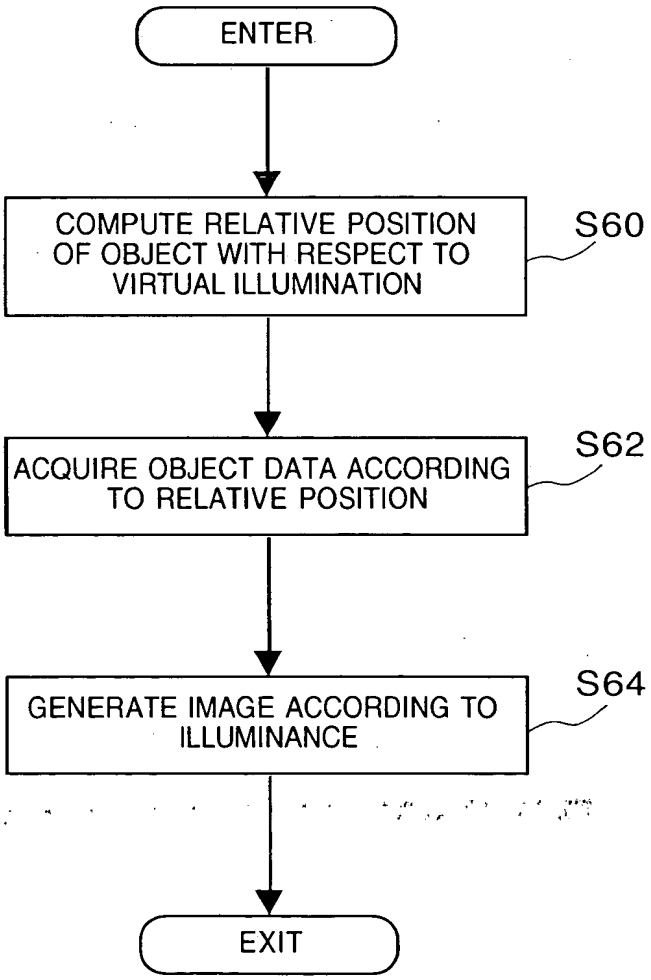
ENTER
COMPUTE RELATIVE POSITION OF OBJECT WITH RESPECT TO VIRTUAL ILLUMINATION
S60
ACQUIRE OBJECT DATA ACCORDING TO RELATIVE POSITION
S62
GENERATE IMAGE ACCORDING TO ILLUMINANCE
S64
EXIT

FIG. 19

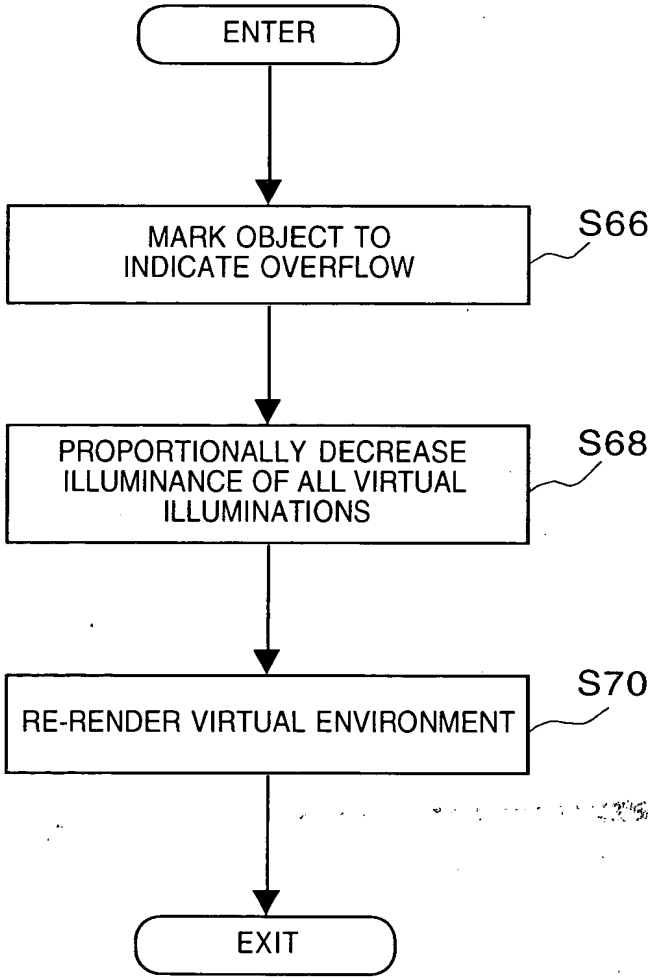
ENTER
MARK OBJECT TO INDICATE OVERFLOW
S66
PROPORTIONALLY DECREASE ILLUMINANCE OF ALL VIRTUAL ILLUMINATIONS
S68
RE-RENDER VIRTUAL ENVIRONMENT
S70
EXIT

FIG. 20

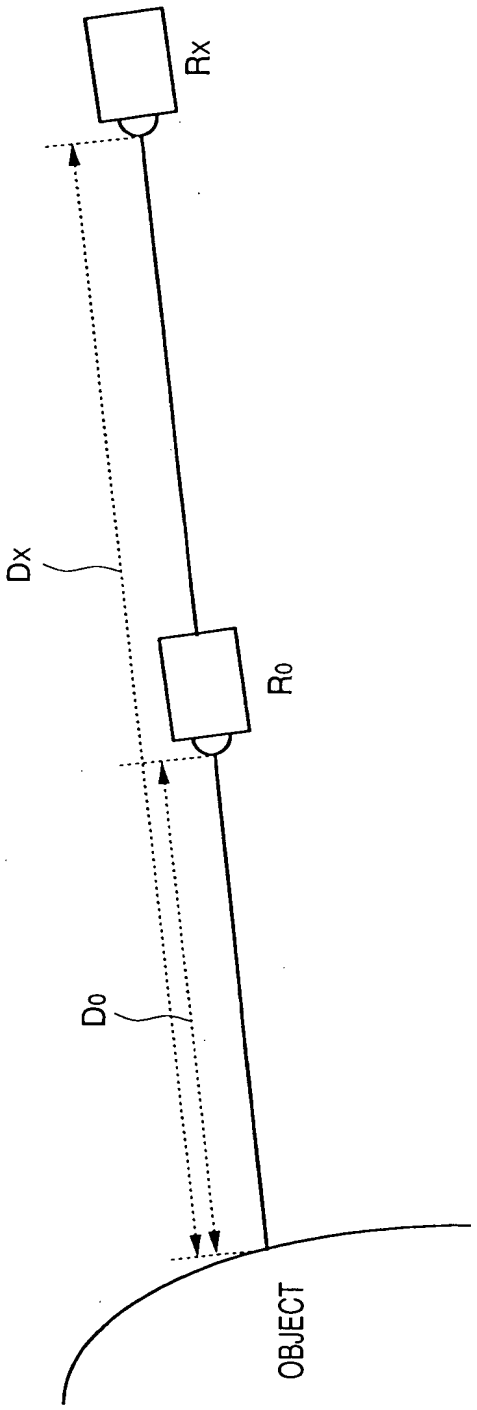

FIG. 21

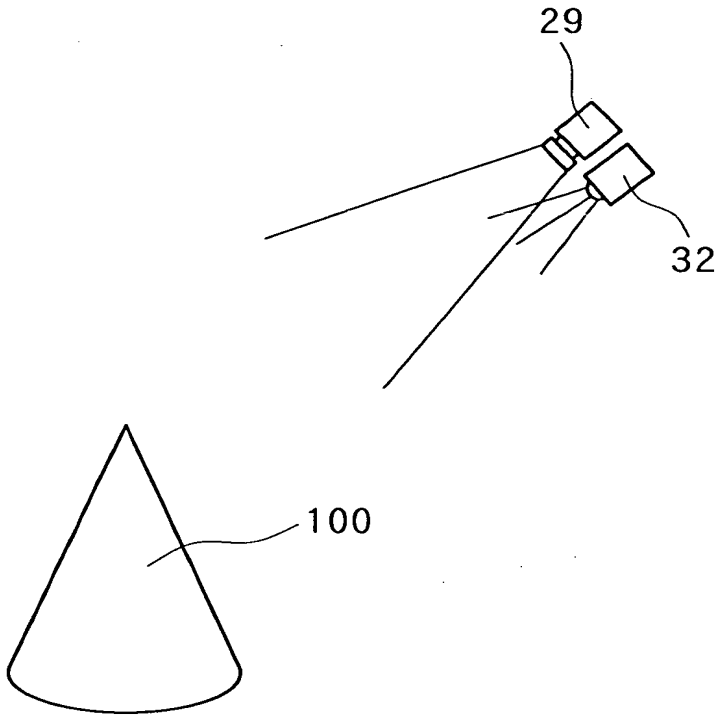

FIG. 22

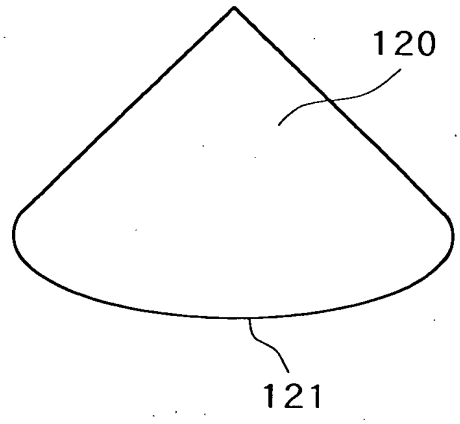

FIG. 23

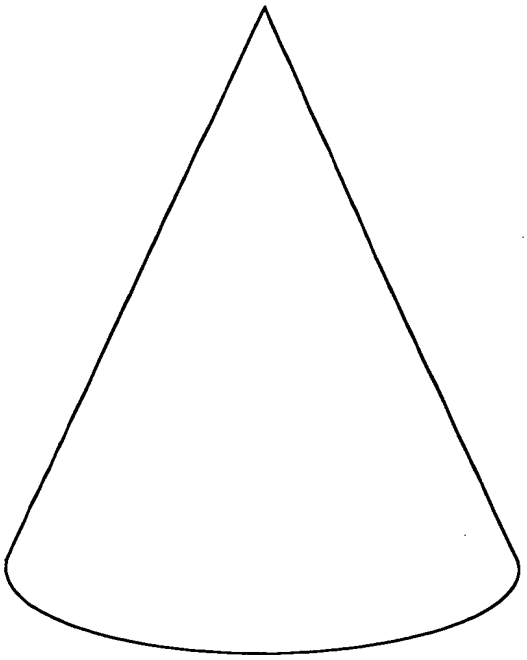

FIG. 24

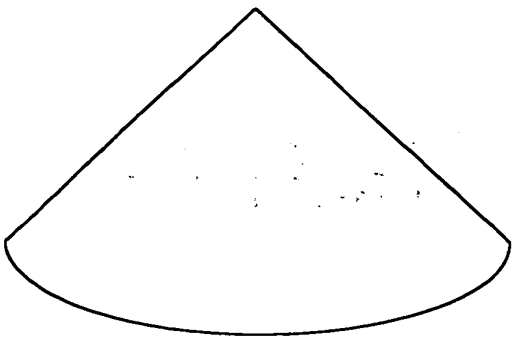

FIG. 25

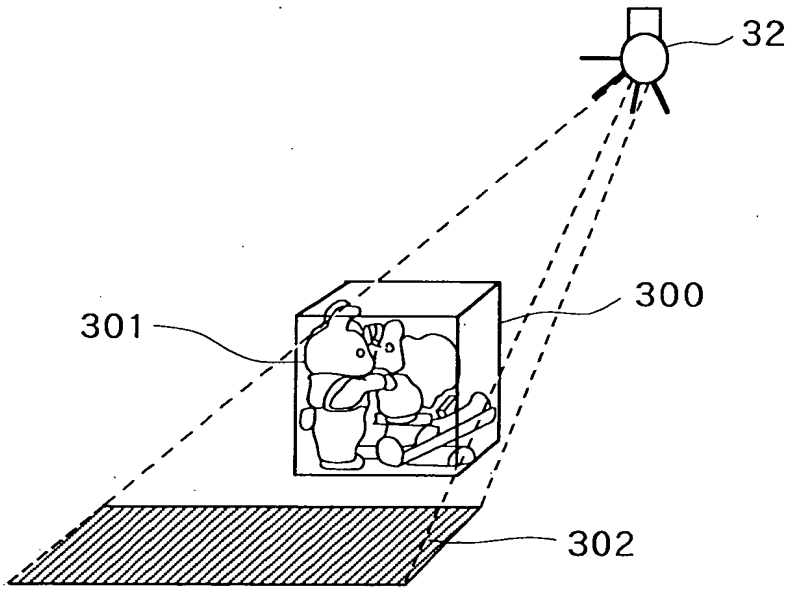

FIG. 26

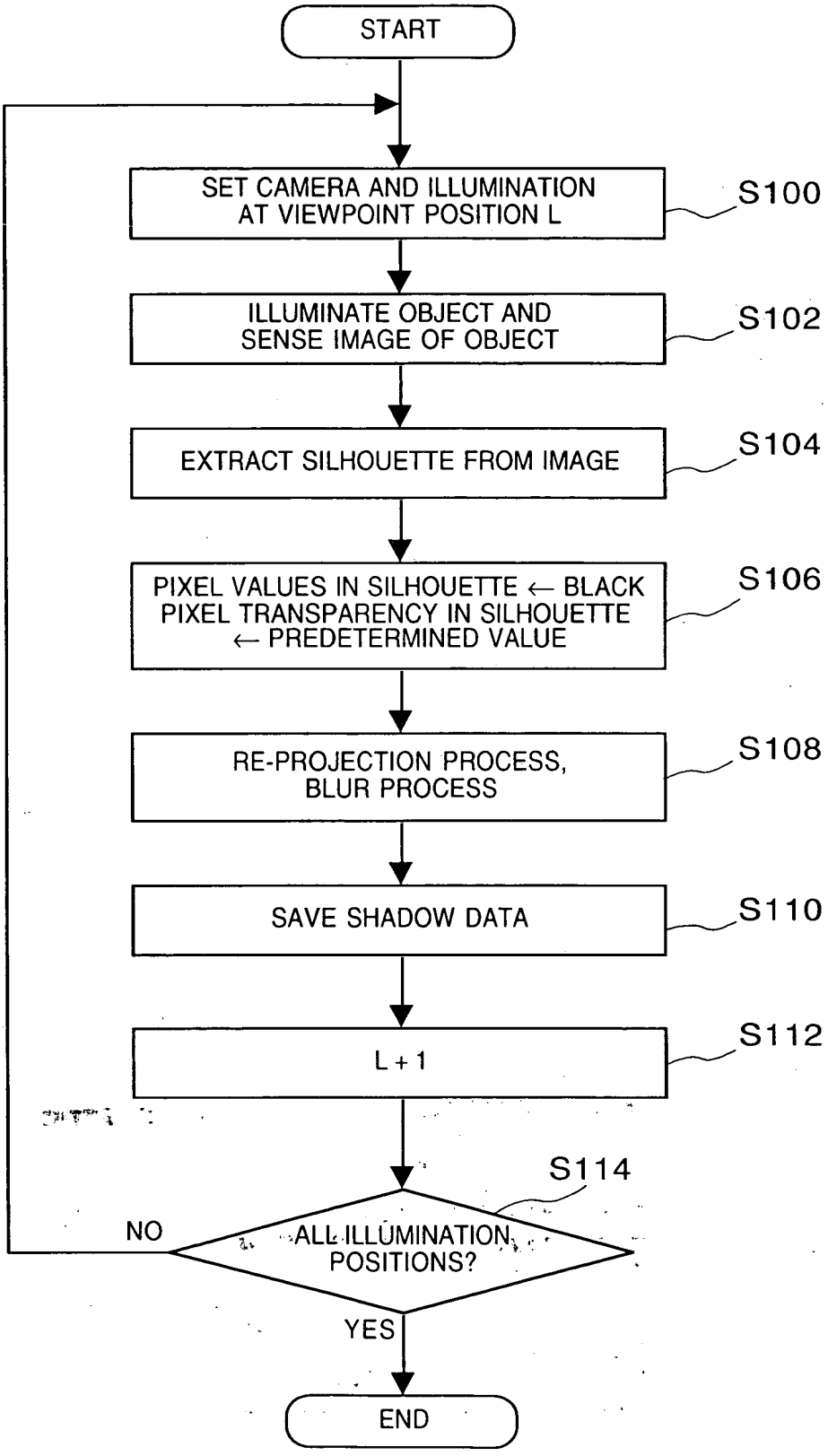
START
SET CAMERA AND ILLUMINATION AT VIEWPOINT POSITION L
S100
ILLUMINATE OBJECT AND SENSE IMAGE OF OBJECT
S102
EXTRACT SILHOUETTE FROM IMAGE
S104
PIXEL VALUES IN SILHOUETTE ← BLACK
PIXEL TRANSPARENCY IN SILHOUETTE ← PREDETERMINED VALUE
S106
RE-PROJECTION PROCESS, BLUR PROCESS
S108
SAVE SHADOW DATA
S110
L + 1
S112
S114
ALL ILLUMINATION POSITIONS?
NO
YES
END

FIG. 27

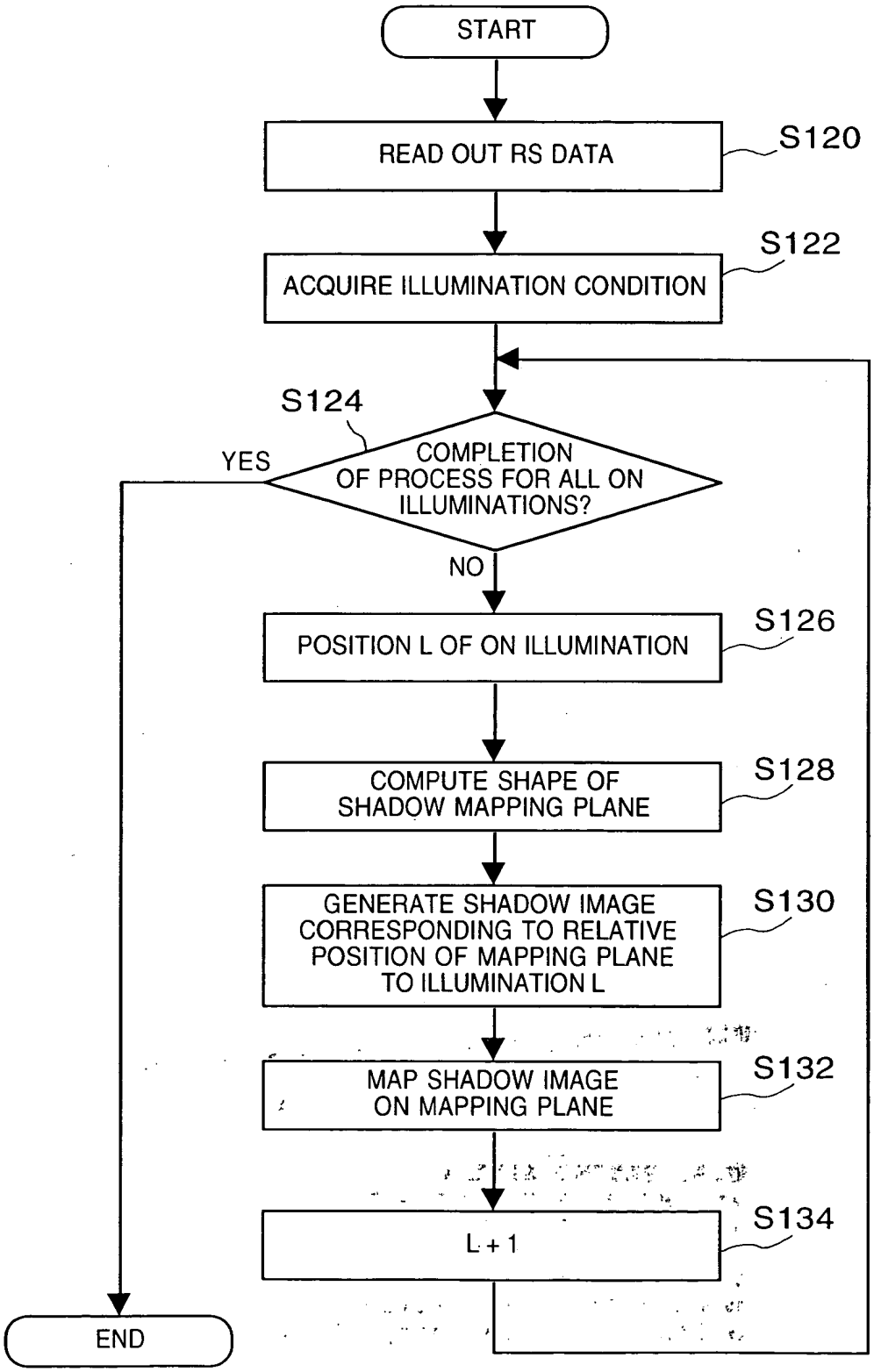
START
READ OUT RS DATA
S120
ACQUIRE ILLUMINATION CONDITION
S122
S124
COMPLETION OF PROCESS FOR ALL ON ILLUMINATIONS?
YES
NO
POSITION L OF ON ILLUMINATION
S126
COMPUTE SHAPE OF SHADOW MAPPING PLANE
S128
GENERATE SHADOW IMAGE CORRESPONDING TO RELATIVE POSITION OF MAPPING PLANE TO ILLUMINATION L
S130
MAP SHADOW IMAGE ON MAPPING PLANE
S132
L+1
S134
END

FIG. 28

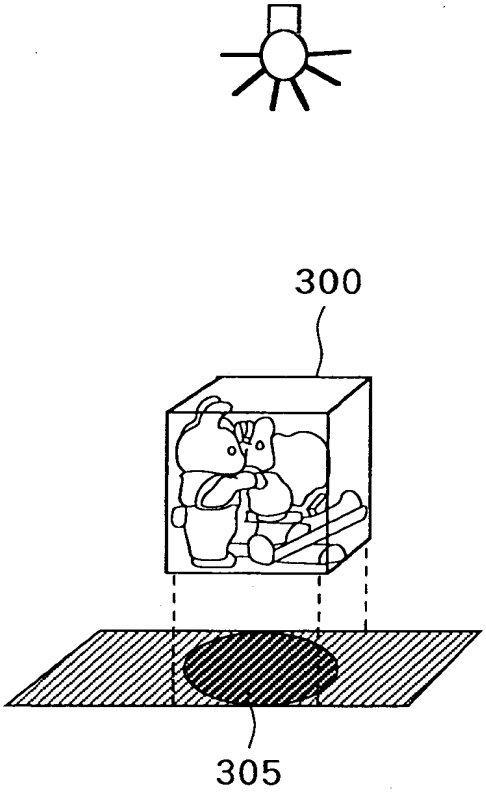

FIG. 29

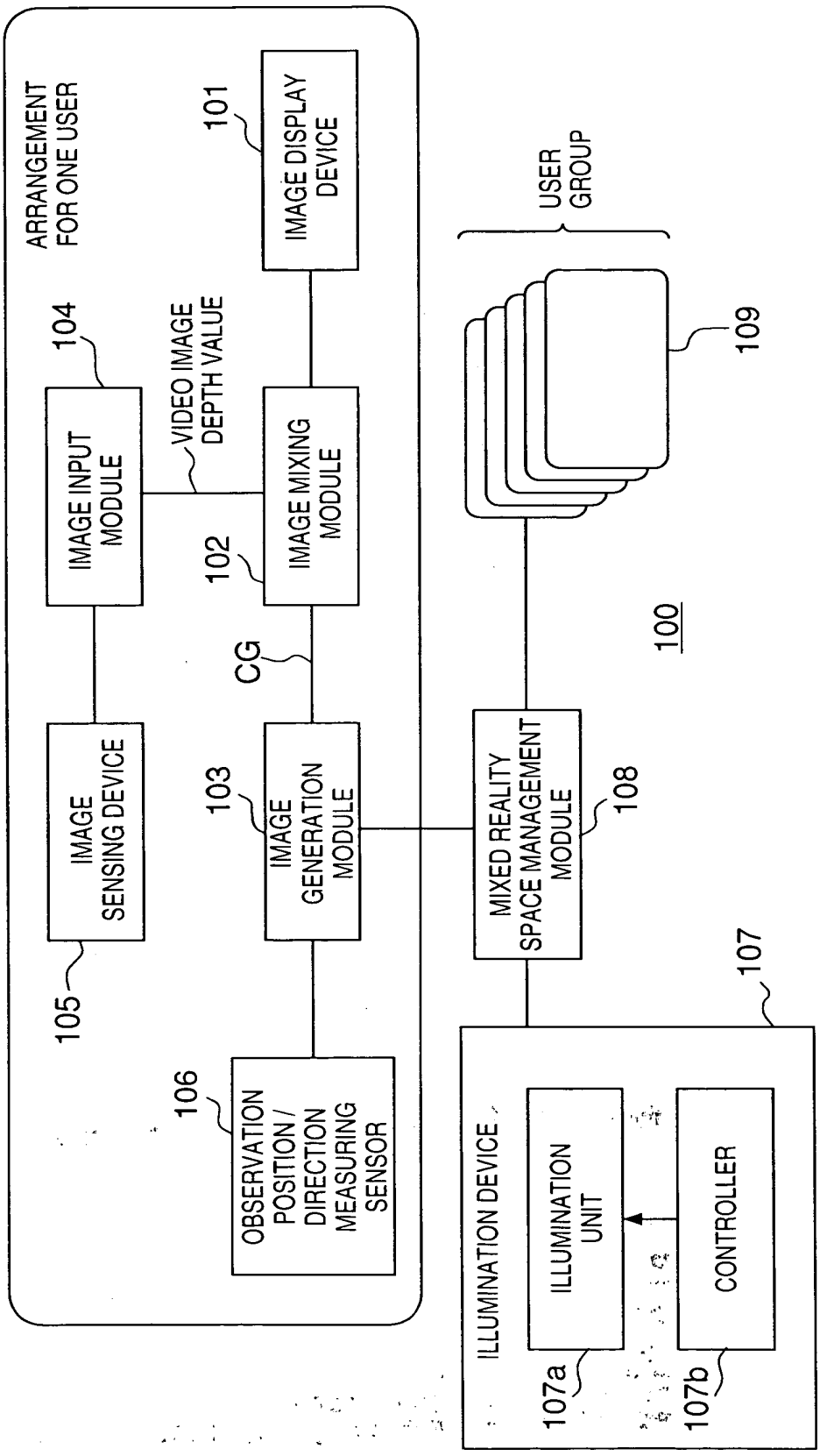
ARRANGEMENT FOR ONE USER
IMAGE DISPLAY DEVICE
101
IMAGE INPUT MODULE
104
VIDEO IMAGE DEPTH VALUE
IMAGE MIXING MODULE
102
CG
IMAGE SENSING DEVICE
105
IMAGE GENERATION MODULE
103
OBSERVATION POSITION / DIRECTION MEASURING SENSOR
106
MIXED REALITY SPACE MANAGEMENT MODULE
108
USER GROUP
109
100
ILLUMINATION DEVICE
107
ILLUMINATION UNIT
107a
CONTROLLER
107b

FIG. 30

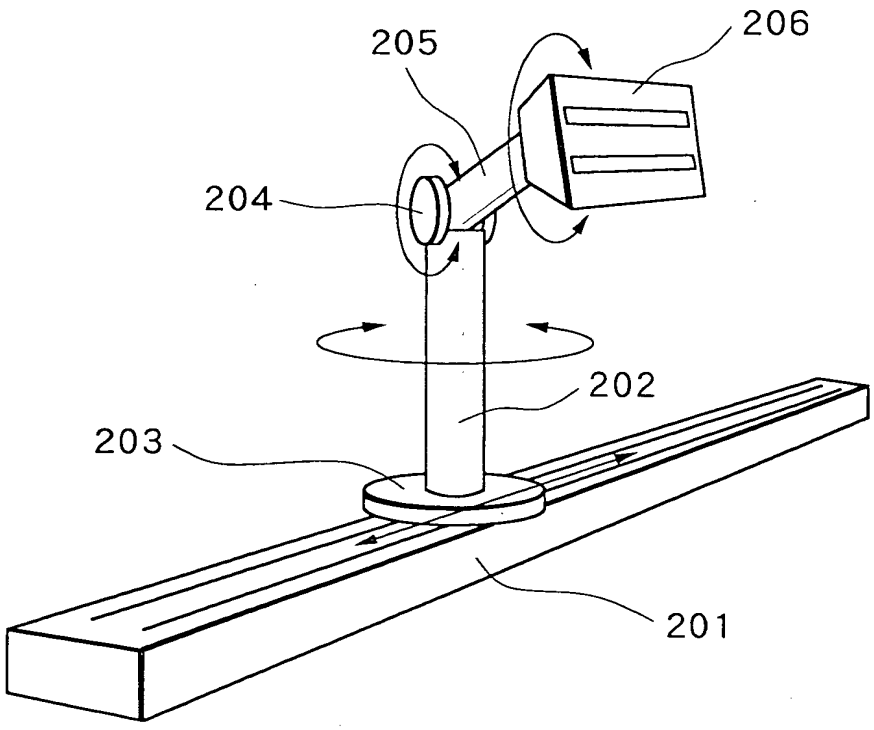

FIG. 31

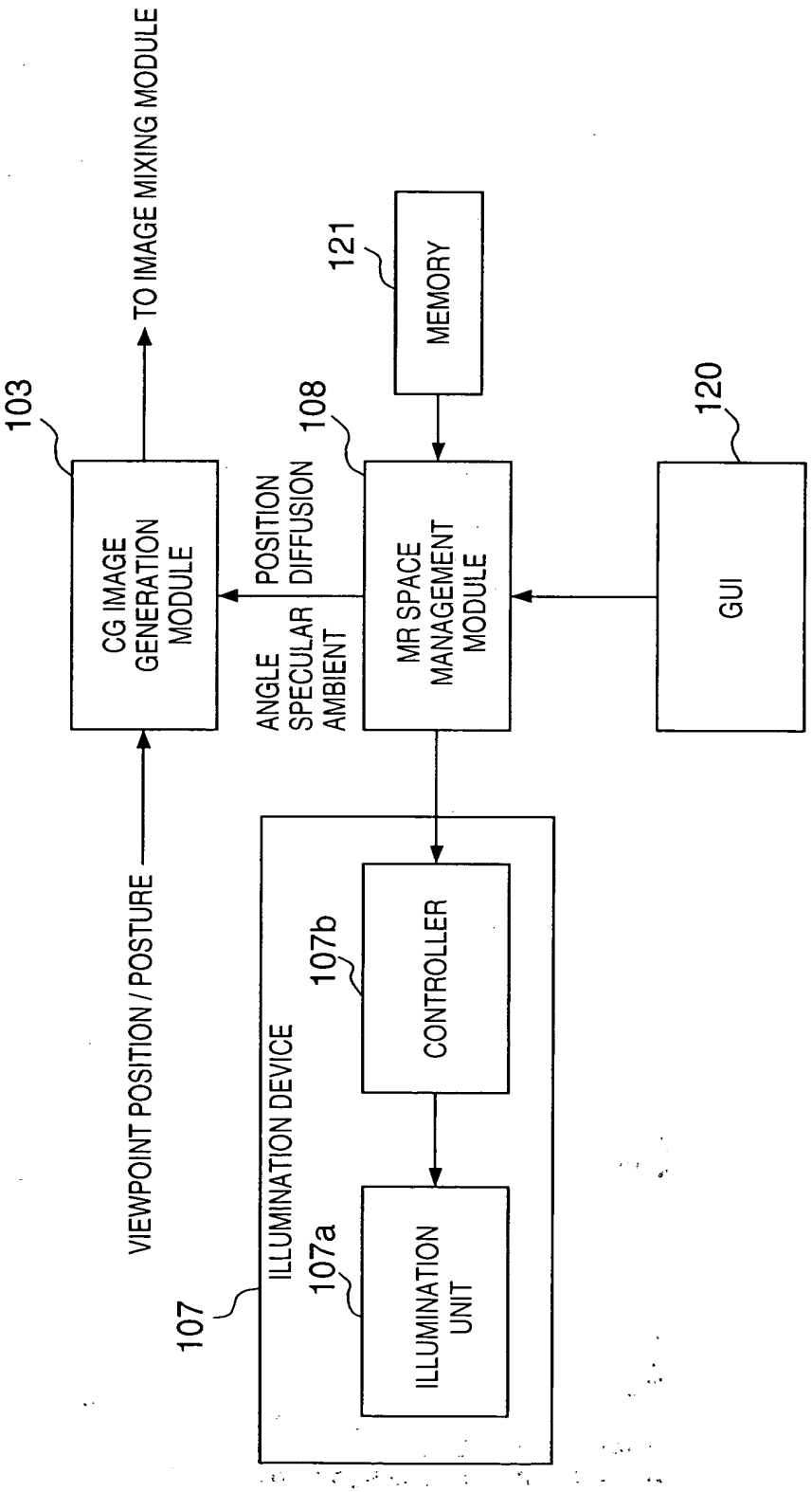
TO IMAGE MIXING MODULE
103
CG IMAGE GENERATION MODULE
POSITION
DIFFUSION
ANGLE
SPECULAR
AMBIENT
108
MR SPACE MANAGEMENT MODULE
121
MEMORY
120
GUI
VIEWPOINT POSITION / POSTURE
107
ILLUMINATION DEVICE
107a
ILLUMINATION UNIT
107b
CONTROLLER

FIG. 32

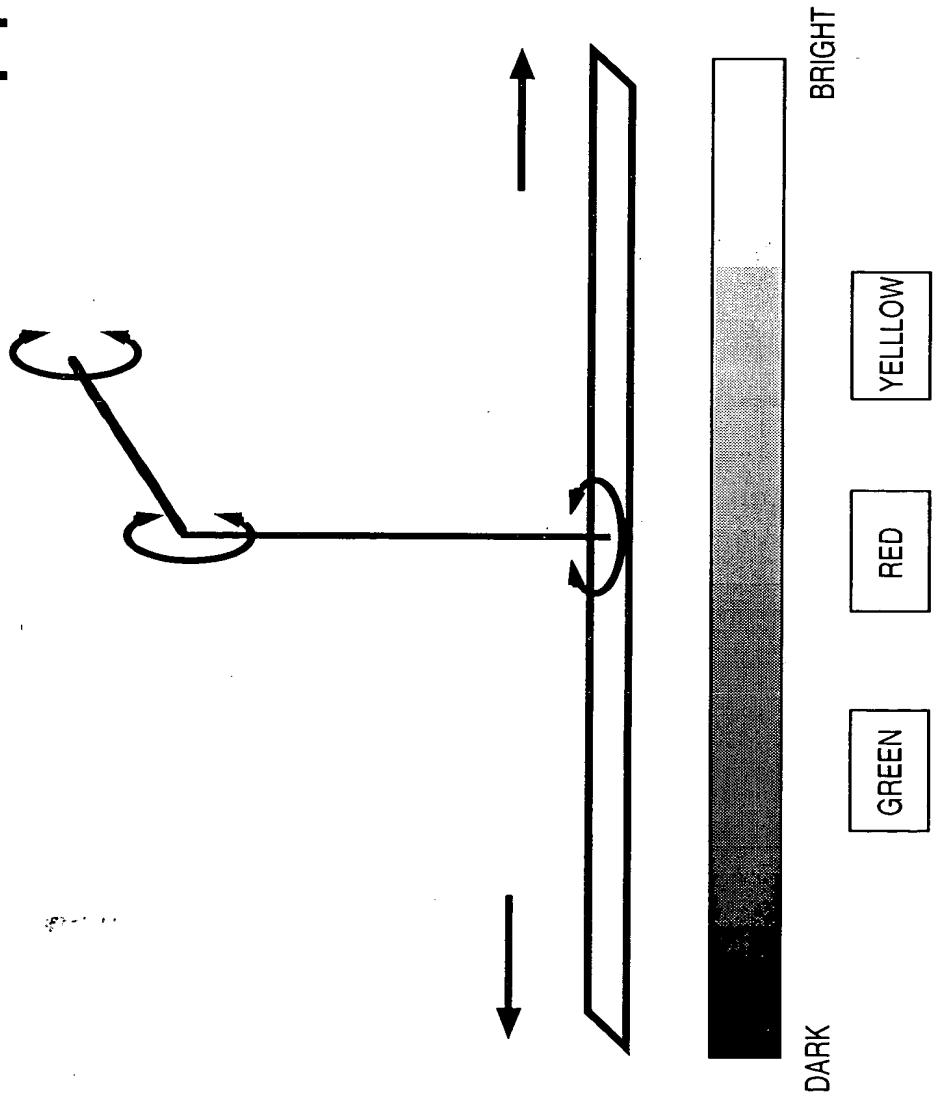

FIG. 33

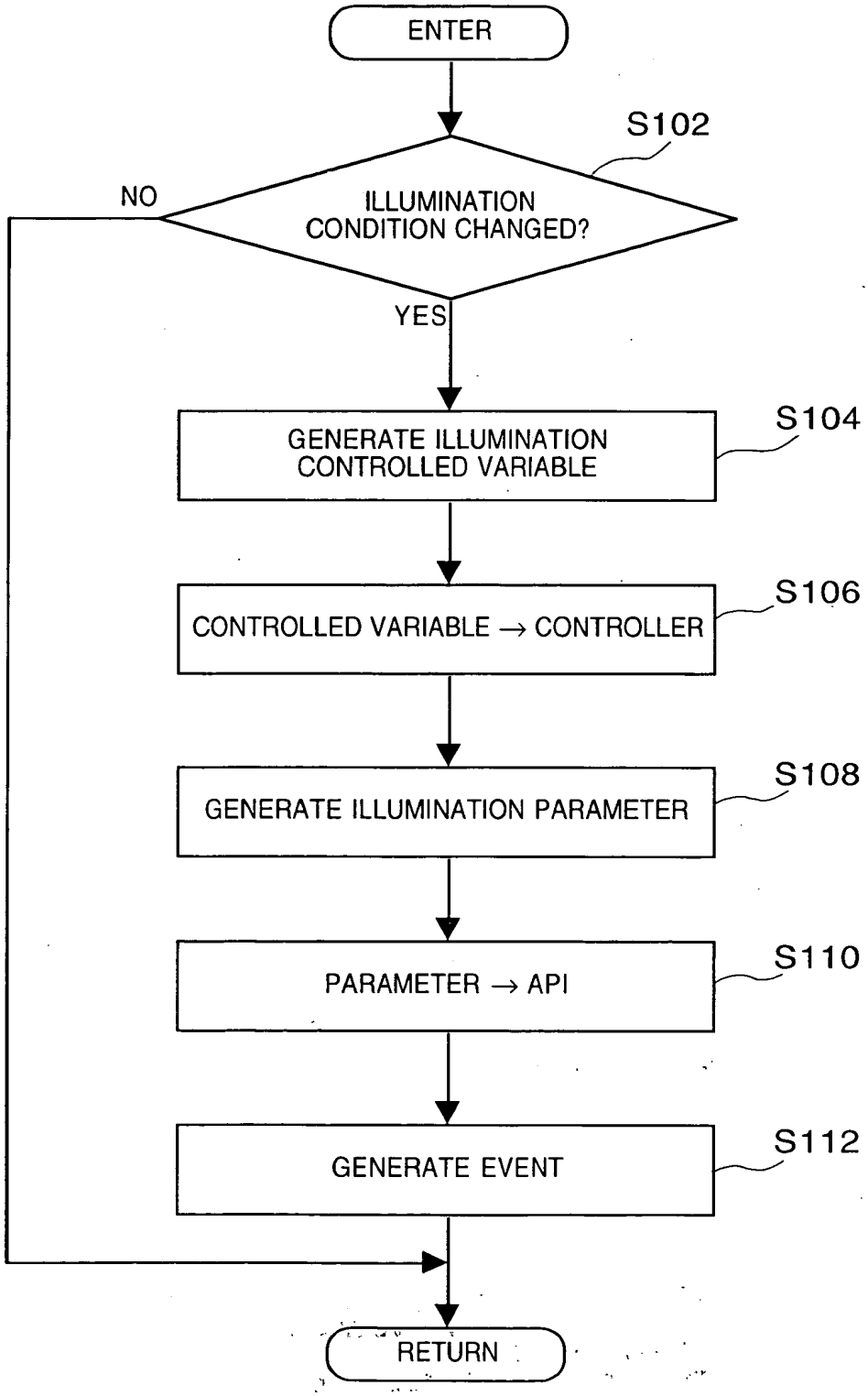
ENTER
S102
ILLUMINATION CONDITION CHANGED?
NO
YES
GENERATE ILLUMINATION CONTROLLED VARIABLE
S104
CONTROLLED VARIABLE → CONTROLLER
S106
GENERATE ILLUMINATION PARAMETER
S108
PARAMETER → API
S110
GENERATE EVENT
S112
RETURN

FIG. 34

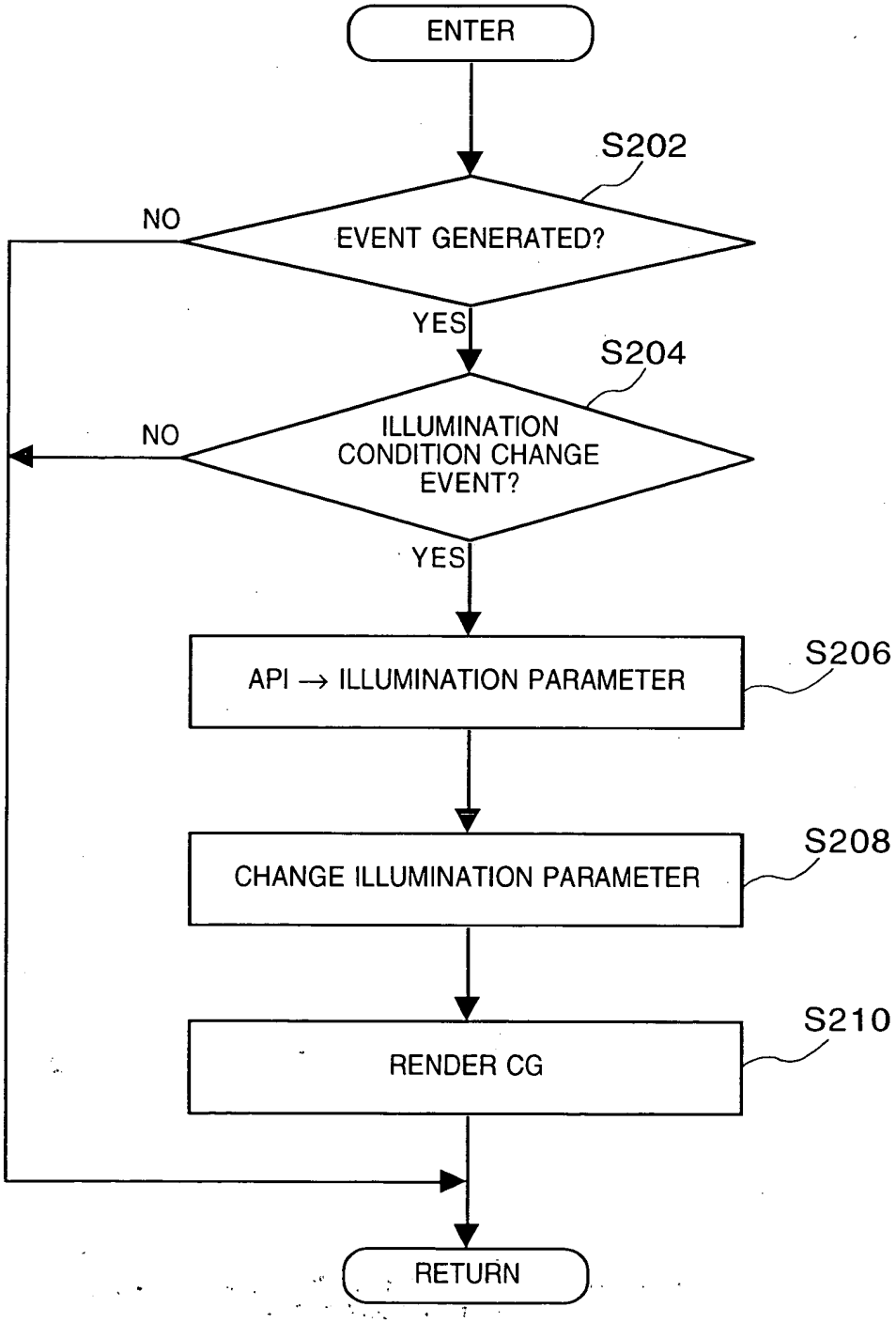
ENTER
S202
EVENT GENERATED?
NO
YES
S204
ILLUMINATION CONDITION CHANGE EVENT?
NO
YES
API → ILLUMINATION PARAMETER
S206
CHANGE ILLUMINATION PARAMETER
S208
RENDER CG
S210
RETURN

FIG. 35

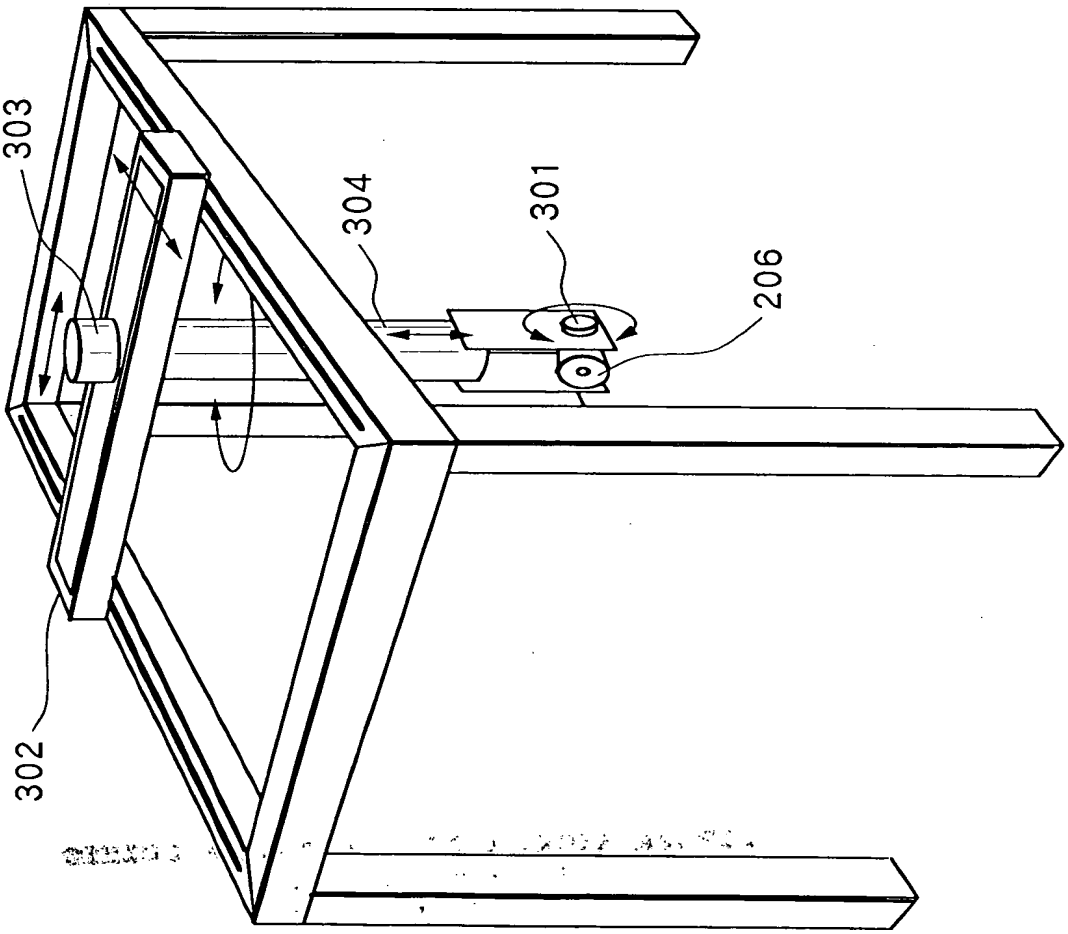

FIG. 36

ILLUMINATION POSITION (n)	RAY SPACE DATA RS (L_n)
L_1	RS (L_1)
L_2	RS (L_2)
⋮	⋮
L_k	RS (L_k)

FIG. 37

ILLUMINATION POSITION (n)	SHADOW DATA SHADOW (L_n)
L_1	SHADOW (L_1)
L_2	SHADOW (L_2)
⋮	⋮
L_k	SHADOW (L_k)

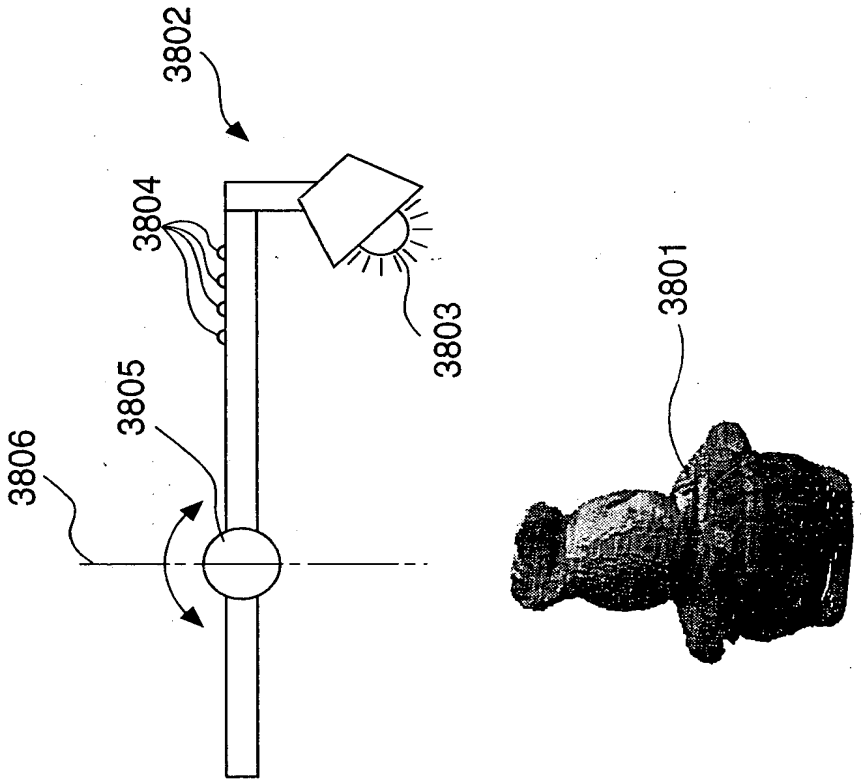

FIG. 38A

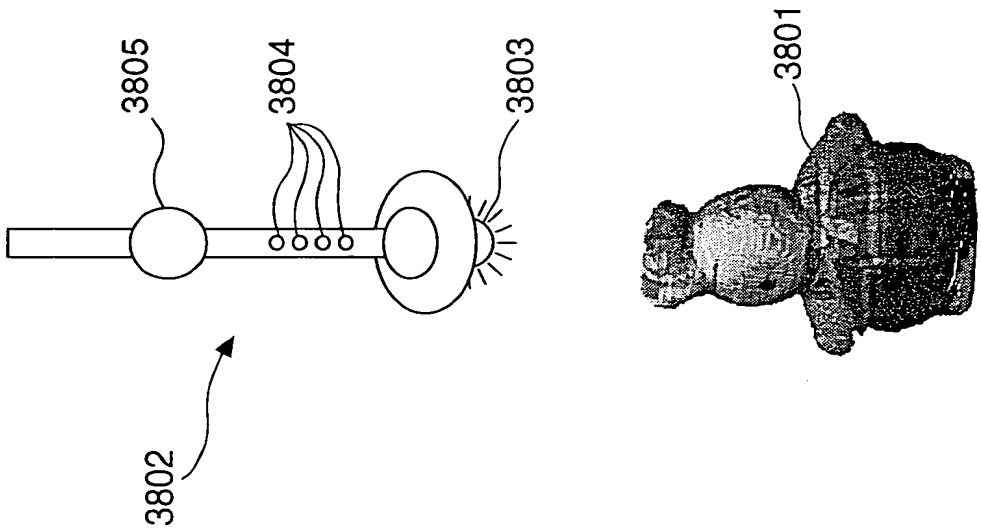

FIG. 38B

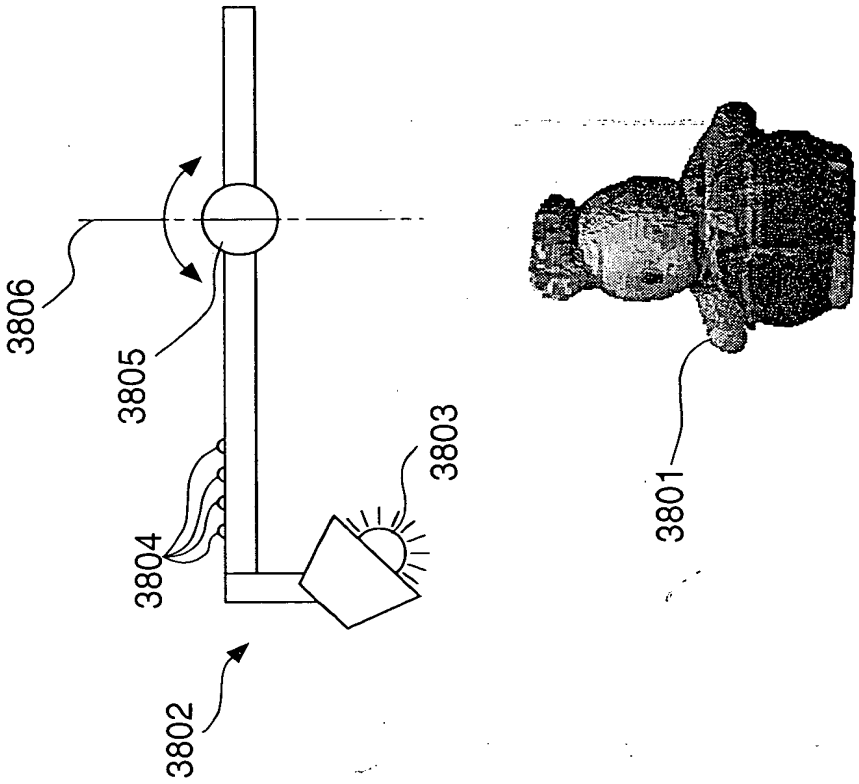

FIG. 38C